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SOIL BLOWING AND DUST STORMS

By CHARLES E. KELLOGG, *senior soil scientist, Division of Soil Survey, Soil Investigations, Bureau of Chemistry and Soils*

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INTRODUCTION

The dust storms of the spring of 1934 were the worst in the history of the Northwest. During that time the skies were repeatedly darkened by dust clouds over the entire northern Great Plains. Some of these clouds even reached as far as the Atlantic coast in early May. Nearly every year a few dust storms are expected, but after the spring rains have come and the new crops have started, the dust clouds usually cease. The bulk of the material carried by these storms comes from the great wheatlands; but as there was no particular increase in plowed land in the spring of 1934, some more specific cause for these phenomenally severe dust storms must be found.

SEVERE DROUGHT THE FUNDAMENTAL CAUSE

The specific cause is not hard to find. Rainfall deficiencies had been reported for several years at the stations of the United States Weather Bureau in the northern Great Plains, and at the same time summer temperatures had been rising. The soil had become increasingly drier until reserves of subsoil moisture were essentially nonexistent. The general condition of increasing dryness was followed in the early spring by an unusual rainfall deficiency. As a result, those soils which are susceptible to soil blowing were in a particularly loose, dry state, and as a further result of the drought had little or no protective covering of vegetation.

In figure 1 are reproduced charts, prepared by the United States Weather Bureau, showing the percentage of normal precipitation, by States, for the year June 1933 to May 1934, inclusive, and for the

spring of 1934. The areas most affected centered around the Dakotas and western Minnesota, but severe conditions of rainfall deficiency extended down into Kansas, east to Ohio, and west to central Montana and Colorado. Impressive proof that the condition was not only one of immediate drought but also of growing moisture defi-

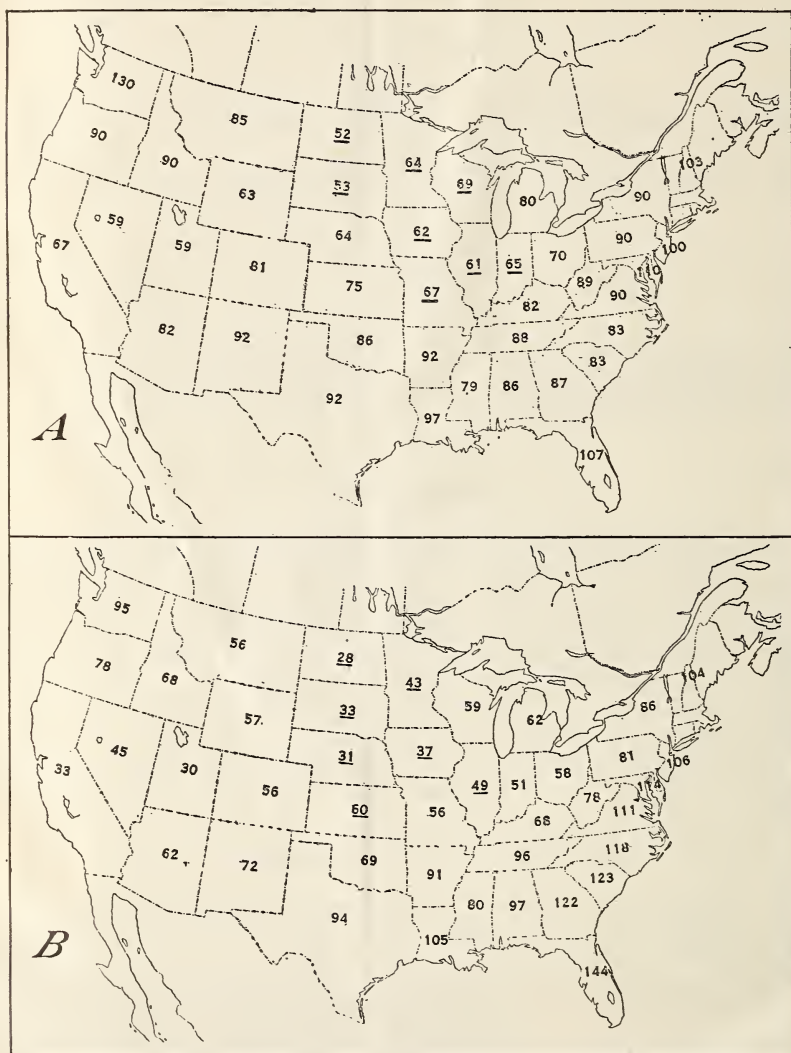


FIGURE 1.—Percentage of normal precipitation, by States. Underlined figures indicate lowest percentages of record: A, June 1933 to May 1934, inclusive; B, spring (March-May) 1934.

ciency is supplied by the Weather Bureau records. For example, at St. Paul the deficiency for the past 22 years had been about 46 inches. During the past 8 years there had been an average of 3 inches less than the normal rainfall each year. Thus the recent drought, coming as it did in the northern Great Plains after a prolonged period

of rainfall deficiency was especially serious and was the factor largely responsible for the unprecedented dust storms.

GENERAL STORM GROWS FROM LOCAL AREAS

The general dust storms, such as the one which reached the Atlantic coast in May 1934, are very disquieting and unhealthy. Their importance, as far as soil and plants are concerned, does not depend so much upon themselves as upon the conditions which they indicate. These storms grow from an almost infinite number of small, local areas. The unsteady wind blowing unevenly over the dry loose soil, churns some of it up into the air. When the surface of the earth is dry and hot, currents of air passing upward carry a portion of this dust into the higher strata. Only relatively small upward currents of air are required to keep the fine dust particles held in suspension. Once up in the high strata, the dust is frequently carried thousands of miles from its original source.

The serious damage to soil and plants occurs in the local areas of movement. In order to be moved by the wind the soil must be dry, loose, and unprotected by vegetation or other cover. Naturally such conditions are frequently to be found in the desert. In the region of somewhat more rainfall, sufficient vegetation (short grass) covers the land to prevent blowing except in the steeper places, on the fresh levees along streams, and where intensive overgrazing has destroyed the vegetation. During dry periods considerable dust has always been blown up from these places. In certain areas, especially in the semiarid Southwest, overgrazing has become somewhat more severe in recent years, and the amount of material moved by the wind has increased during the past several years; but the dust storms from such regions rarely, if ever, reach anything like the proportions of the dust storm of May 1934.

The bulk of the soil material carried in that storm arose from the wheatlands of Canada, the Dakotas, Minnesota, Nebraska, and the adjacent country—the general region of the wheat belt showing an increasing deficiency of rainfall during the past few years and especially in 1934. In years past there has been some soil blowing almost every spring, and occasionally in the autumn and winter, throughout the Great Plains. Probably these storms have become worse since the time large areas were first used for dry farming. The increased severity of the dust storms, however, is much more nearly correlated with the weather conditions than with the percentage of land under cultivation.

LOCAL MOVEMENT HARMFUL TO SOIL AND PLANTS

Locally this blowing frequently does a tremendous amount of harm. Seeds or the roots of small plants may be uncovered and destroyed. The rapidly blown sand particles have the effect of cutting and destroying the tender young plants in adjacent fields. Where the soil is especially susceptible to blowing, the surface layer may be entirely removed, frequently exposing a hard, limy, or otherwise unproductive layer beneath. This loosened wind-blown soil material may be drifted against fences, buildings, or other obstructions, like snow (fig. 2). Drifts frequently fill the ditches and obstruct the highways. Plants may be buried by these drifts.

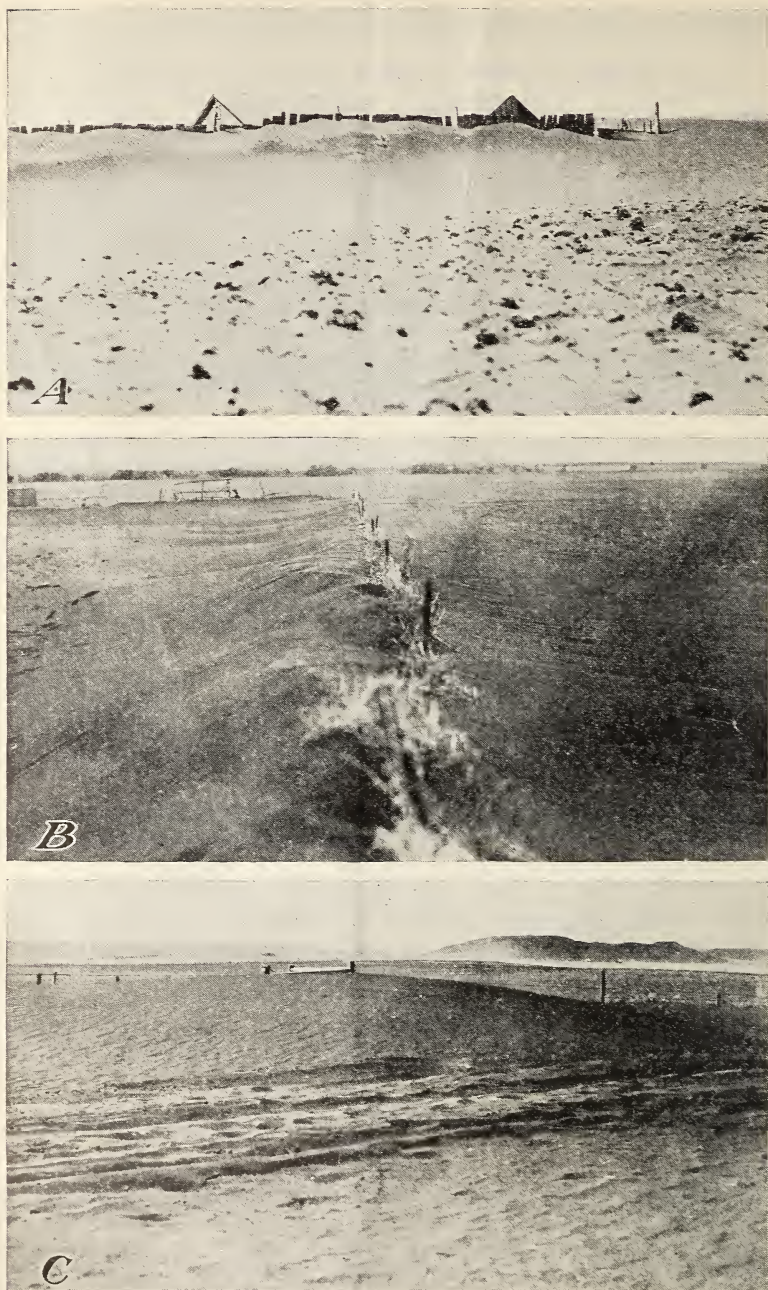


FIGURE 2.—The effect of recent soil blowing in South Dakota. These piles of soil are composed largely of relatively heavy clay, not sand as one might judge from their general appearance: A, A ranch house in South Dakota saved from burial by a wooden fence; B, a typical fence line adjoining fields where proper precautions were not taken for the prevention of soil blowing; C, soil blown into road drifts like snow where improperly protected.

AMOUNT OF BLOWING DEPENDS UPON SOIL TYPE

Soils vary tremendously in their susceptibility to blowing, depending upon their physical nature, especially the texture (size of the individual soil grains) and the structure (arrangement of these grains into clods, crumbs, etc.). It is commonly known that uniform fine sand, "blow sand", moves readily with the wind where the surface is unprotected. Sand dunes are common elements in the landscape along sandy lake and ocean beaches. Also artificially drained peat land, when the exposed surface becomes dry and pulverized, is known to be subject to serious damage by the wind.

In the Great Plains heavy soils, silt loams, and even clays, are frequently subject to movement where the structural conditions are favorable and the texture is uniform. The fine particles of clay and silt may cling together to form small aggregates about the size of sand particles (but lighter in weight) which move easily. Or these small particles of clay and silt may cling together in large aggregates which cannot be moved by the wind. The ideal structural condition is one in which the aggregates are too large to blow and yet not so large as to interfere with cultivation and plant growth.

The uniformity of the texture and structure bears an important relation to the stability of a soil. In some instances after a little soil has been removed, pebbles and small clods are exposed which serve to protect the finer soil aggregates beneath. An extreme example of this condition is the well-known "desert pavement." If, however, the soil consists of uniform loose sand or has a uniform fine crumb or fine granular structure, considerable surface soil may be removed if dry conditions prevail.

PROPER METHODS OF TILLAGE IMPORTANT

Not only are the natural physical conditions important in determining the susceptibility of a soil to wind erosion, but so also is the condition of the soil as influenced by the kind of management practiced by the farm operator. Where the soil is managed with a view to protecting it from blowing, the more capable and skillful farmers have been able to prevent wind erosion except possibly for the most erosive soils.

Tillage methods devised to protect the surface soil by small clods and trash are especially desirable. When farmers from the more eastern parts of the country, where soil blowing is rarely a serious problem, came into the Great Plains they generally used the tillage methods which they had practiced previously. In the Dakotas, land was plowed during the summer, fall, or early spring for spring wheat. In the western parts of this area frequent plowing tends to form a hard layer or "plow sole" just underneath the surface in many types of soil. Not only that, but the soil is left loose and open, especially if dry weather follows. Unless the spring months are unusually moist the soil remains very loose and open after spring plowing. In their efforts to prevent soil blowing the better farmers aim to use the tillage implements best adapted to the purpose at the time, depending on the condition of the soil, the previous crop, and the weather. The moldboard plow is extensively used and is not

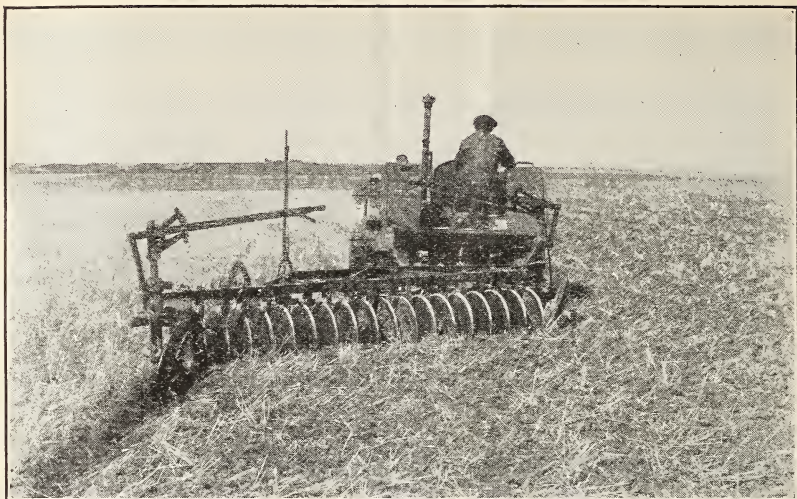


FIGURE 3.—A one-way disk in use on a wheat farm. Note how the stubble remains in the very surface soil.



FIGURE 4.—The type of duck-foot cultivator used by many of the more progressive farmers. This implement leaves the soil in small ridges with trash and little clods which protect the fine earth from blowing.

an undesirable tool in some areas. On some of the larger wheat farms the one-way disk (fig. 3) is in favor. The duck-foot cultivator (fig. 4) gives especially good service. The stubble and other trash should not be plowed entirely under, but part of it should remain on the surface to act as protection. As excessive tillage makes the surface soil more susceptible to being blown it should be avoided.

Farther south in the Great Plains some farmers plow up lister ridges crosswise to the prevailing winds. Later these ridges may be cultivated back into the rows with only a small loss of grain. The blowing out of winter wheat is checked by running the listers at intervals of 1 rod or so. Figure 5 shows a lister in use for planting row crops. These tillage practices are mentioned as examples of effective methods, adapted to the particular type of land, that have proved useful in controlling soil blowing. The discontinuance of burning stubble land may be cited as another desirable change in practice. The protection of the stubble on the land and of the organic matter

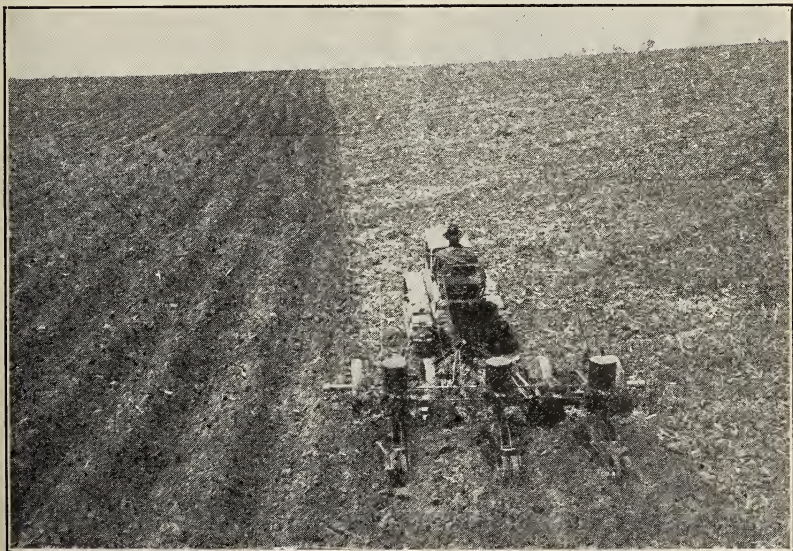


FIGURE 5.—The lister is frequently used, especially in the central and southern parts of the Great Plains, to make ridges of soil at right angles to the prevailing winds and greatly reduce soil blowing.

which it furnishes when the soil is cultivated are important in controlling soil blowing.

Another important practice recommended by some farmers in Montana and other parts of the Great Plains is known as "strip farming." In Montana, for example, north-and-south strips about 10 rods wide are alternately seeded and fallowed. After the seedlings are high enough to protect the soil, the alternate strips are cultivated with the duck-foot or similar tool. Even where the moldboard plow is used, strip farming is effective. Such a practice, to be most effective, must be adopted on a community basis. Isolated farmers following this practice are not greatly benefited if the adjoining land is allowed to blow badly.

SOME SOIL BLOWING IN GRAZING AREAS

For many years before any of the great grassland region was used for farming there were dust storms in years of great drought—not as serious as the recent one which came from the wheatlands, but nevertheless quite noticeable. In places where animals congregate and tramp out the grass, the soil is exposed to the wind and may be blown out. In some areas where the land has been overgrazed this has been a serious matter. Such blowing depends to a great extent upon the type of soil; overgrazing on some types leads directly to serious blowing in dry periods, while on other types it does not.

The soil blowing that results from overgrazing is, quite obviously, comparatively easy to control. Areas in which the native grasses are killed require considerable attention and, in many instances, restriction on use for a long time before normal grazing can be resumed. During the past few years the more capable ranchers have adopted practices to control the grazing in such a way that full advantage is taken of the pasture but it is not overgrazed. In many instances these plans are on a community basis either through local cooperation or in conjunction with such Federal agencies as the Forest Service or the Indian Service.

SHELTER BELTS ARE USEFUL

Shelter belts have been found quite practical for protection of soil and plants from the wind in parts of the Union of Soviet Socialist Republics having conditions of climate and soil quite similar to those in the eastern part of the Great Plains in North America. Such belts of trees, planted in strips through the fields at right angles to the direction of the prevailing winds, serve to protect the soil from blowing when drought conditions prevail (fig. 6). The chief value lies in the protection of plants against hot winds. The loss of water from the plants is materially reduced.

The use of similar plantings of trees has not been given sufficient trial to prove conclusively its value in the United States, but there exists a considerable possibility of success, especially in the more moist portion of the Great Plains, east of about the hundredth meridian. During the past few years farmers in the northern dry portions of the wheat country, for example in the western Dakotas and eastern Montana, have been unable to grow shelter belts except in the most favored situations and under good care. The climatic difficulty there is not entirely a matter of dryness but is also increased by the suddenness with which the warm weather begins in the spring. Numerous recent studies indicate, however, that by proper selection of species, suitable to the climate and the variable local soil conditions, and by careful management a much greater measure of success with shelter belts may be possible.

CONTROL THROUGH PLANNED LAND USE

A great measure of control of soil blowing may be obtained by an orderly use of land. For example, those types of soil which are most subject to blowing may be kept in permanent pasture or at best

largely in sod crops. It is unnecessary, from a scientific point of view, that the entire region be returned to grass; and certainly such a plan would be undesirable from the standpoint of our national economy. Most farmers throughout this region need to devote each



FIGURE 6.—A shelter belt of 8-year-old Russian mulberry trees in Kansas.

year a portion of their land to pasture and sod crops. Those soil types most subject to blowing could be devoted to these crops. Local adjustments would need to be made, as they are now being made in many instances, but the general percentage of the various crops prob-

ably would not need to be greatly altered to improve the situation tremendously.

Such measures of planned land use usually work themselves out in time, but there can be a considerable saving in human energy and health if our present knowledge is more effectively used to hasten the accomplishment of a desirable stability of the farm unit and community arrangement.

During extremely dry years there always has been and always will be some soil blowing. With a selection of lands for various uses and the wider adoption of superior tillage methods, soil blowing can certainly be reduced, probably to a point such that it will not endanger the agriculture of the region.

SUMMARY

Fundamental responsibility for the great dust storm of 1934 rests with the drought, not only the drought of that one year but the cumulative effect of deficiency of rainfall of several preceding years. There had been a gradual decline in rainfall, together with a gradual increase in temperature over this area for several years.

Drought conditions encourage soil blowing in two ways: (1) Under such conditions the soil is likely to be more loose and pulverized, and (2) the normal protective covering of vegetation, especially of the cereal grains, is retarded or even prevented from growth.

Although some serious blowing occurred locally in the grazing regions, the bulk of the serious soil blowing was in the northern portion of the great wheatlands.

Different soil types vary greatly in their susceptibility to soil blowing, depending on their natural physical characteristics. Those having a uniform texture and a fine granular or crumb structure are the most affected. Adjacent soil types not having these characteristics may be essentially unaffected under similar conditions.

Tillage methods have been developed by the more capable farmers through experience with those tools that give greatly increased control of soil blowing, particularly by throwing up clods or allowing the stubble to remain on the surface. Other practices, such as strip farming, have proved successful.

By taking advantage of known facts, the use of land in this general region ordinarily subject to soil blowing can be so arranged that those soils most likely to blow may be devoted to pasture and sod crops without greatly influencing the total percentage of the various crops. This distribution of pasture and sod crops on those soils which are most susceptible to blowing, together with effective tillage methods on the soils devoted to other crops, can bring about such a great reduction in the present soil blowing that the agriculture of the region will not be endangered from this cause unless droughts continue to become more severe.

SOME DEPARTMENT PUBLICATIONS ON EROSION

Although the following publications are confined mainly to a discussion of water-erosion problems in its various aspects, they may contain suggestions of interest and assistance to the reader. They

may be purchased from the Superintendent of Documents, Government Printing Office, at the prices indicated.

Farmers' Bulletin 1669, Farm Terracing, price 5 cents.

Farmers' Bulletin 1697, Using Soil-Binding Plants to Reclaim Gullies in the South, price 5 cents.

Farmers' Bulletin 1737, Stop Gullies—Save Your Farm, price 5 cents.

Leaflet 82, Controlling Small Gullies by Bluegrass Sod, price 5 cents.

Leaflet 85, Strip Cropping to Prevent Erosion, price 5 cents.

Circular 19, Forests and Floods, price 5 cents.

Circular 33, Soil Erosion a National Menace, price 25 cents.

Circular 178, Artificial Reseeding on Western Mountain Range Lands, price 15 cents.

Technical Bulletin 178, Properties of Soil Which Influence Soil Erosion, price 5 cents.

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